

Ejercicio 1: Para las siguientes funciones de transferencia de 1°, 2° y 3° orden:

$$Gp(s) = \frac{3}{4 * s + 1}$$

```
CC>g1=3/(4*s+1)
CC>time(g1)

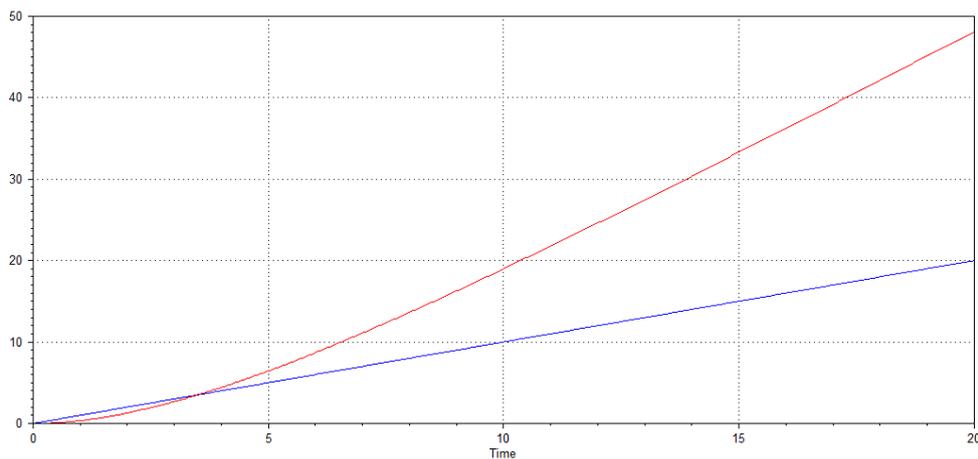
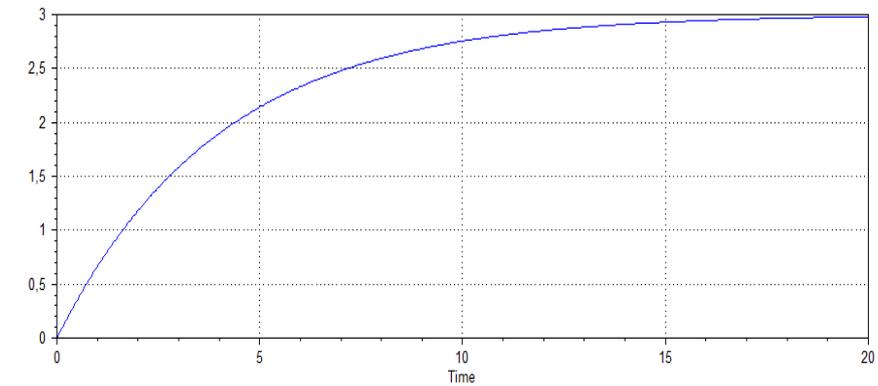
CC>time(1/s, g1/s)
CC>time(g1*s)
CC>w=0.1
CC>u=w/(s^2+w^2)
CC>u
```

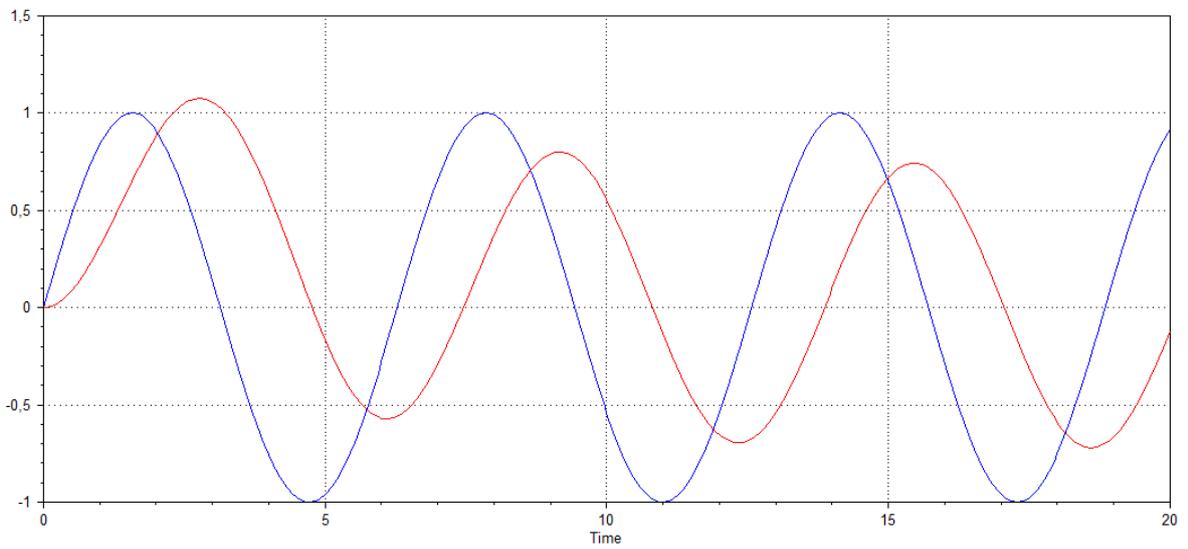
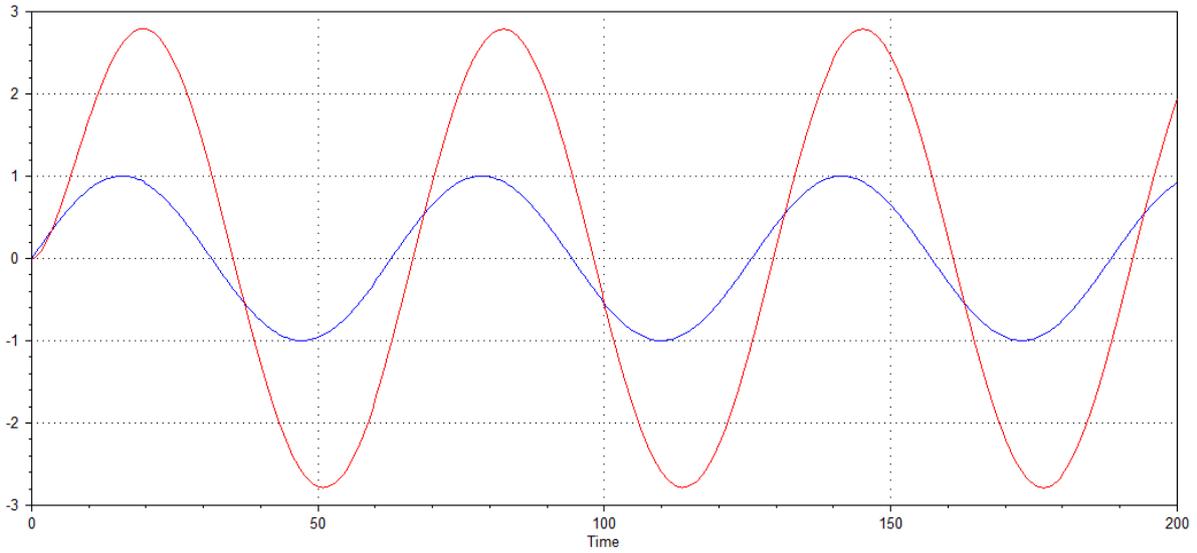
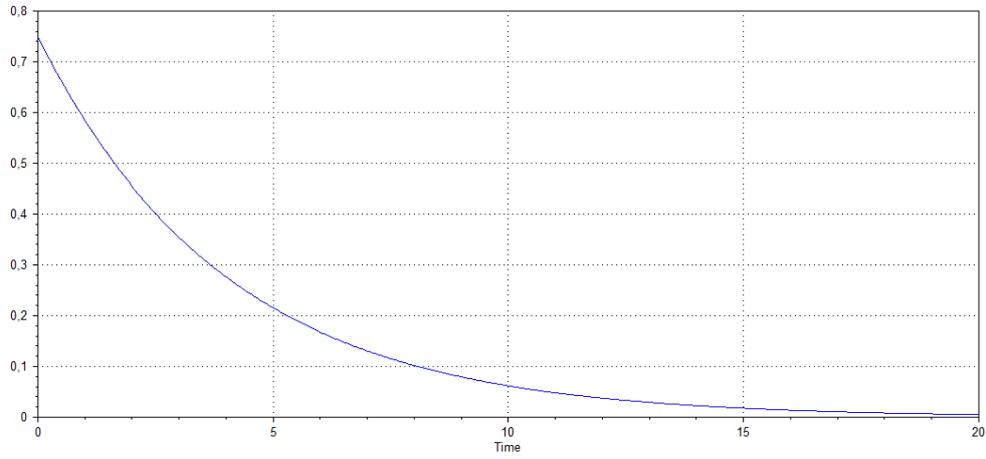
$$u(s) = \frac{0,1}{s^2 + 0,01}$$

```
CC>time(u*s, g1*u*s)
CC>w=1
CC>u=w/(s^2+w^2)
CC>u
```

$$u(s) = \frac{1}{s^2 + 1}$$

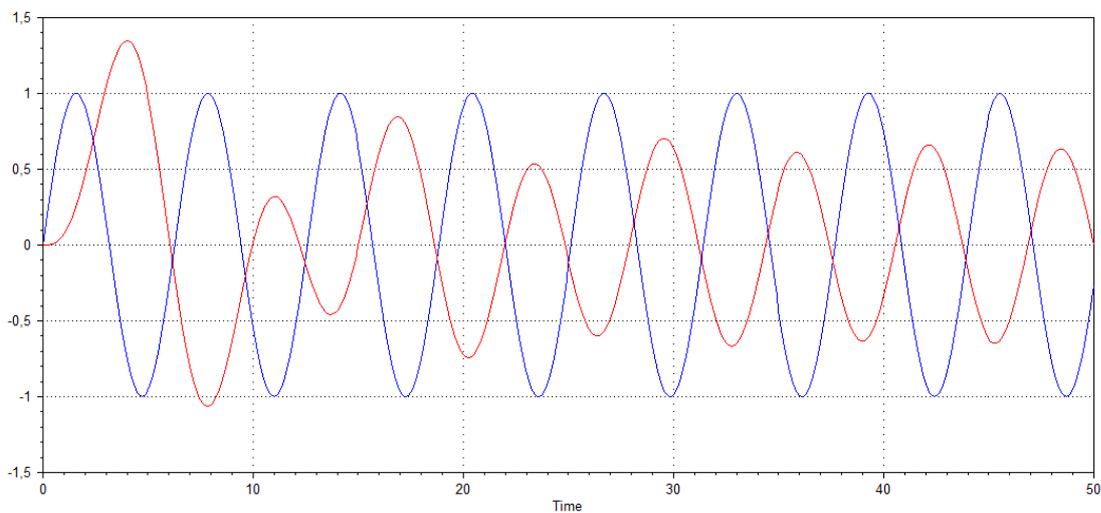
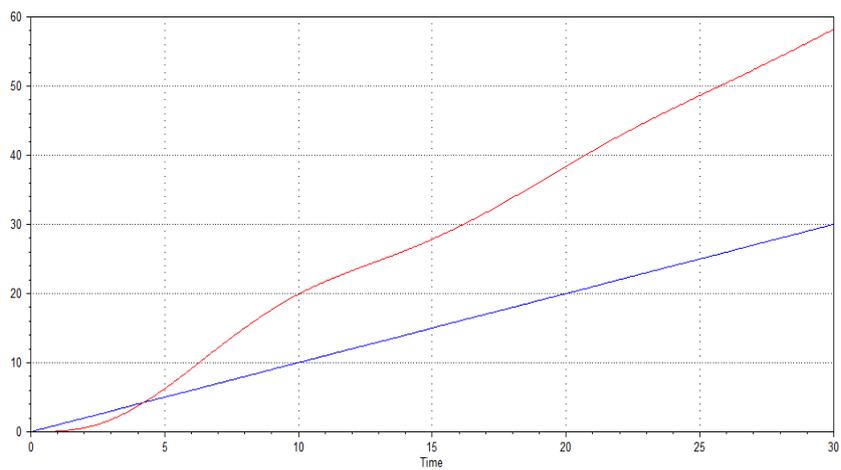
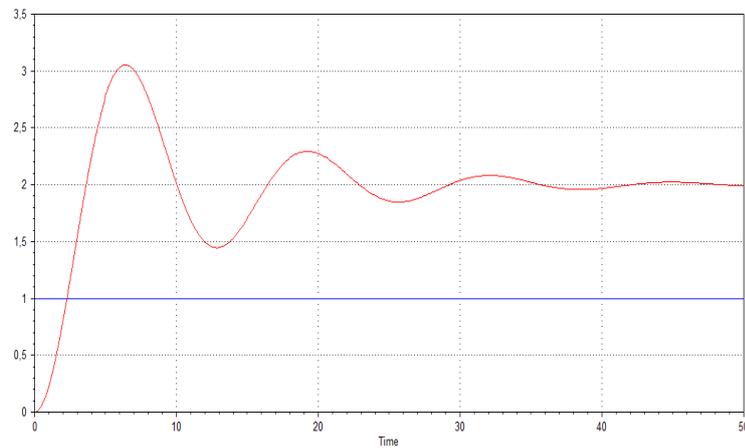
```
CC>time(u*s, g1*u*s)
CC>
```





$$Gp(s) = \frac{2}{4 * s^2 + 0,8 * s + 1}$$

```
CC>g2=2/(4*s^2+0.8*s+1)
CC>time(1, g2)
CC>time(1/s, g2/s)
CC>w=1
CC>u=w/(s^2+w^2)
CC>time(u*s, g2*u*s)
CC>
```



$$Gp(s) = \frac{2}{4 * s^2 + 4 * s + 1}$$

$$Gp(s) = \frac{2}{4 * s^2 + 9 * s + 1}$$

$$Gp(s) = \frac{5 * e^{-2*s}}{((3 * s + 1) * (s + 1) * (0,5 * s + 1))}$$

Graficar las respuestas para las siguientes entradas:

- escalón unitario
- rampa unitaria
- impulso unitario
- seno (wt) (para w=0.1 y 1)

Ejercicio 2: Para la siguiente función de transferencia donde K= 3, $\tau_1=5$, $\tau_2=2$ y $\tau_3=0,4$ y $\tau_d=2$ seg

$$G(s) = \frac{K * e^{-\tau_d * s}}{((\tau_1 * s + 1) * (\tau_2 * s + 1) * (\tau_3 * s + 1))}$$

a-Graficar las respuestas sin tiempo muerto y con tiempo muerto para las siguientes entradas:

- escalón unitario
- rampa unitaria
- impulso unitario
- seno (wt) (para w=0.1, 1 y 2)

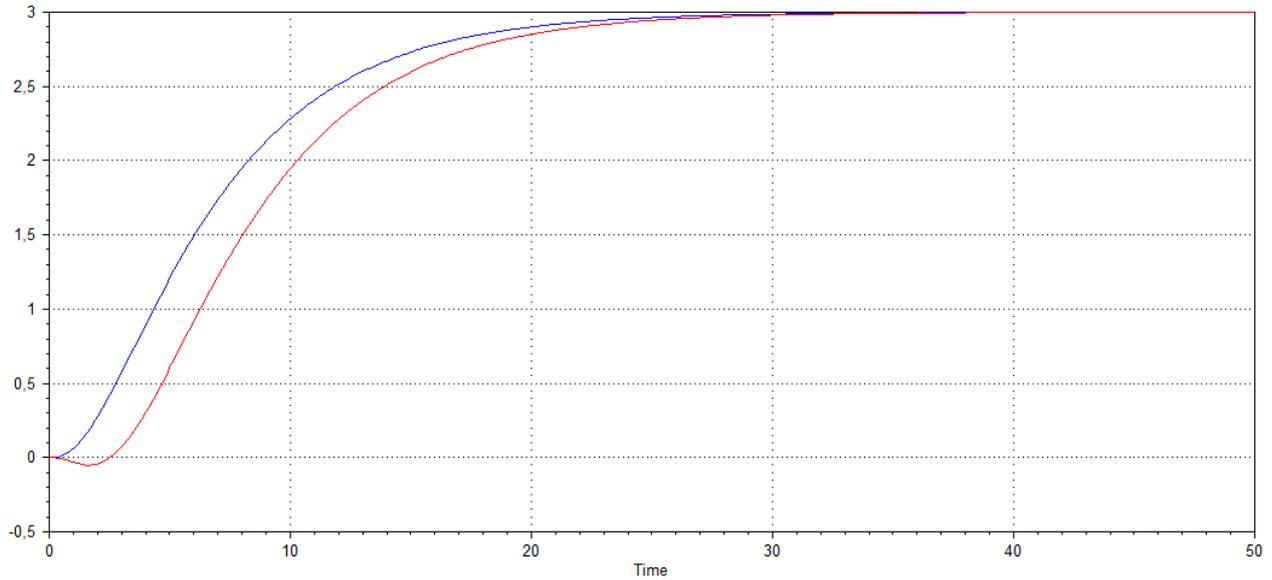
```
CC>g3=3/((5*s+1)*(2*s+1)*(0.4*s+1))
CC>g3

g3(s) =
      3
-----
(5s+1)(2s+1)(0,4s+1)

CC>tm=pade(2,1)
CC>tm

tm(s) =
      -s+1
-----
      s+1

CC>time(g3, g3*tm)
[...]
```

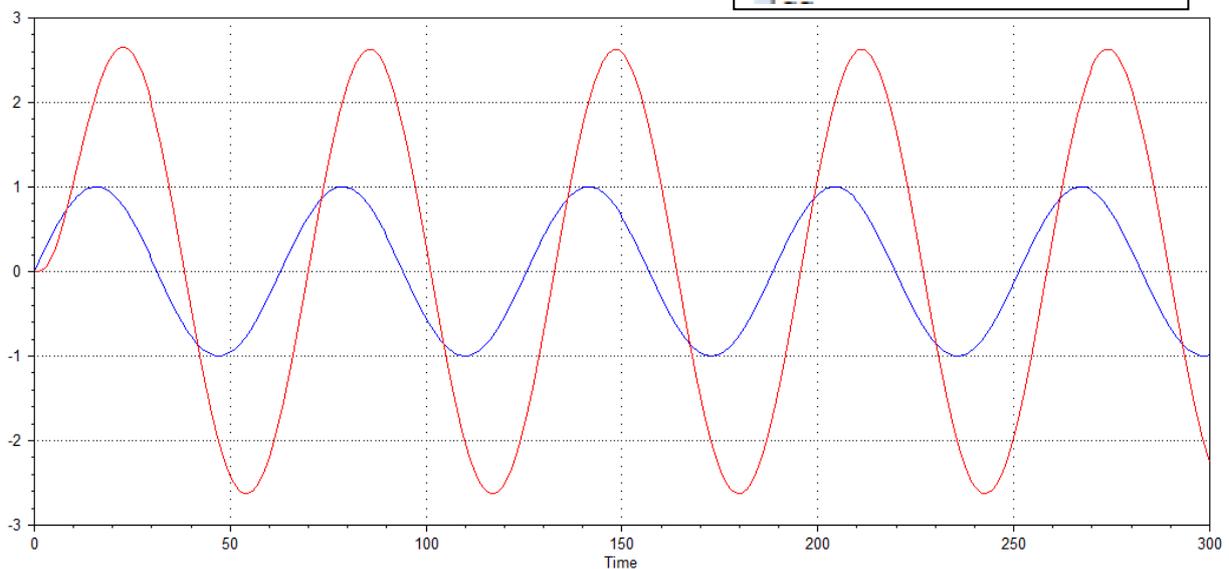


a1-Determinar gráficamente para el sistema SIN TIEMPO MUERTO la relación de amplitudes y desfases para la entrada $\sin wt$ con cada valor de w .

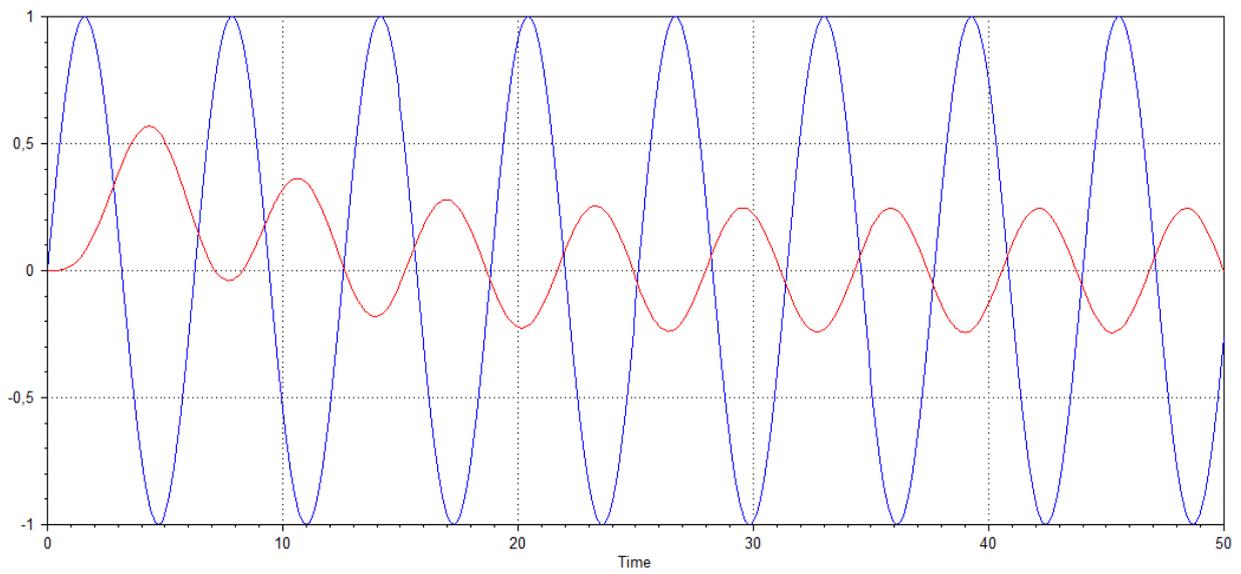
- $\text{seno}(wt)$ (para $w=0.1, 1$ y 2)

```
CC>w=0.1
CC>u=w/(s^2+w^2)
CC>time(u*s, g3*u*s)
CC>w=2
CC>u=w/(s^2+w^2)
CC>time(u*s, g3*u*s)
CC>w=1
CC>u=w/(s^2+w^2)
CC>time(u*s, g3*u*s)
```

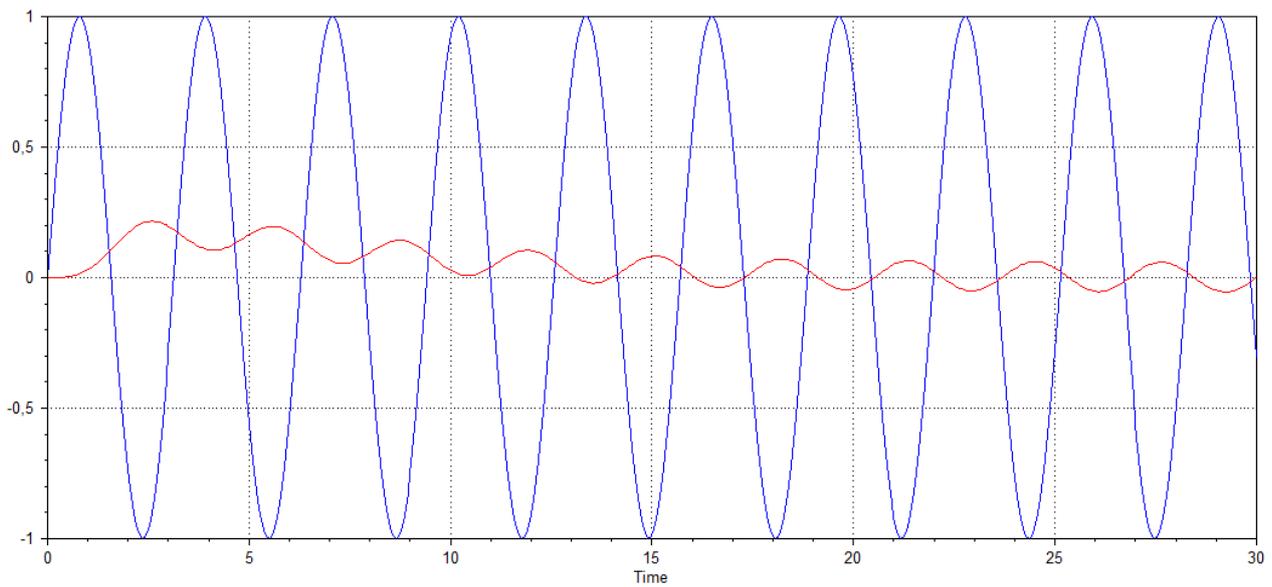
W=0,1



W=1



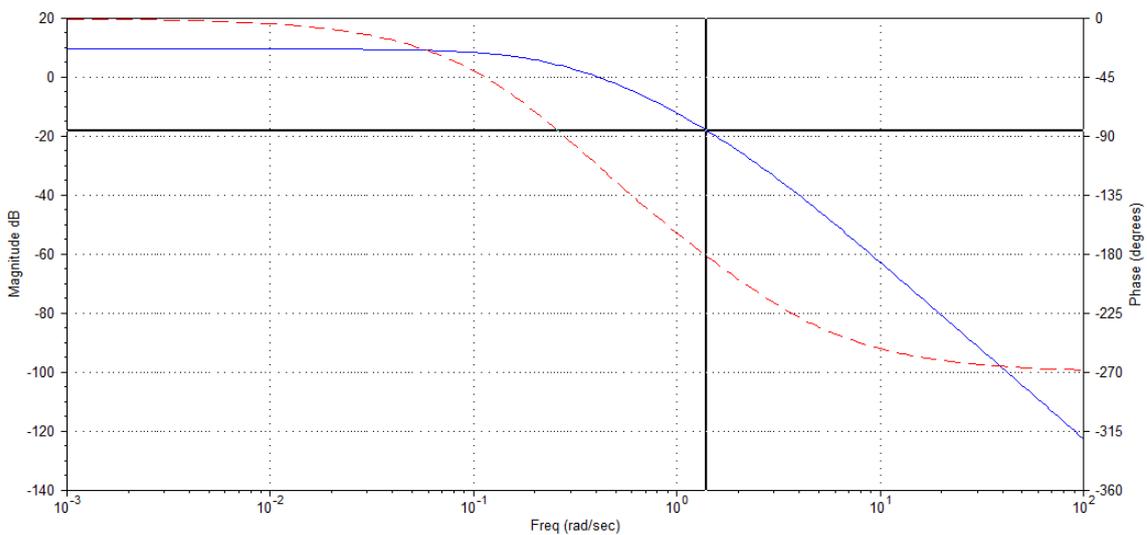
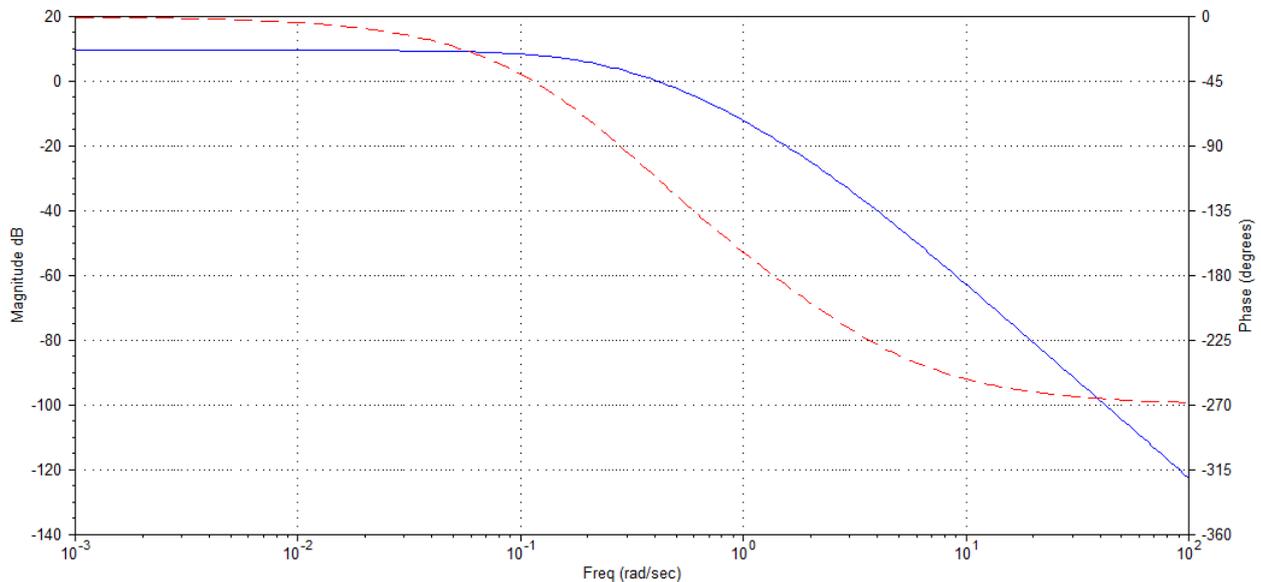
W=2



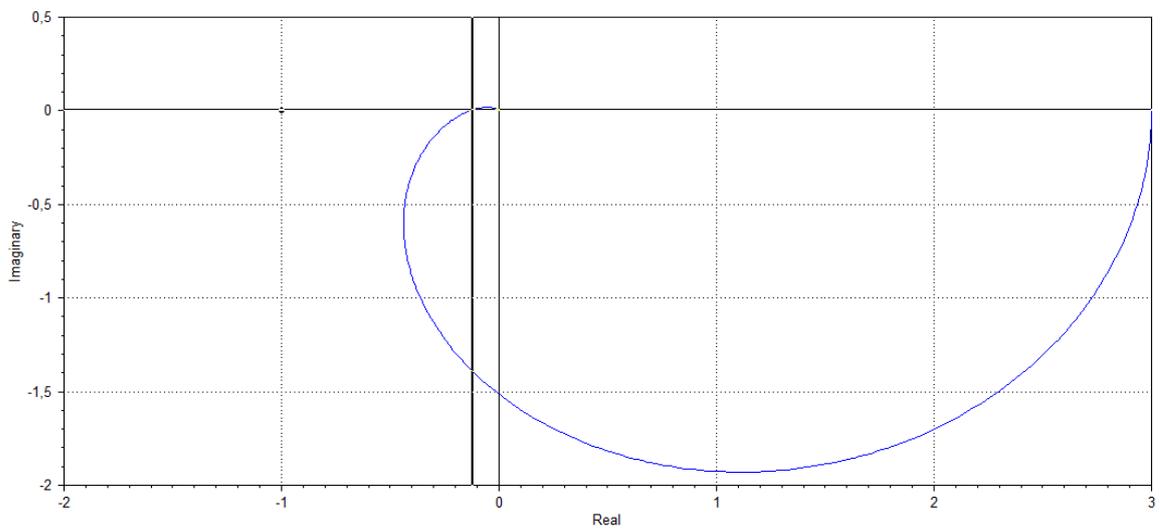
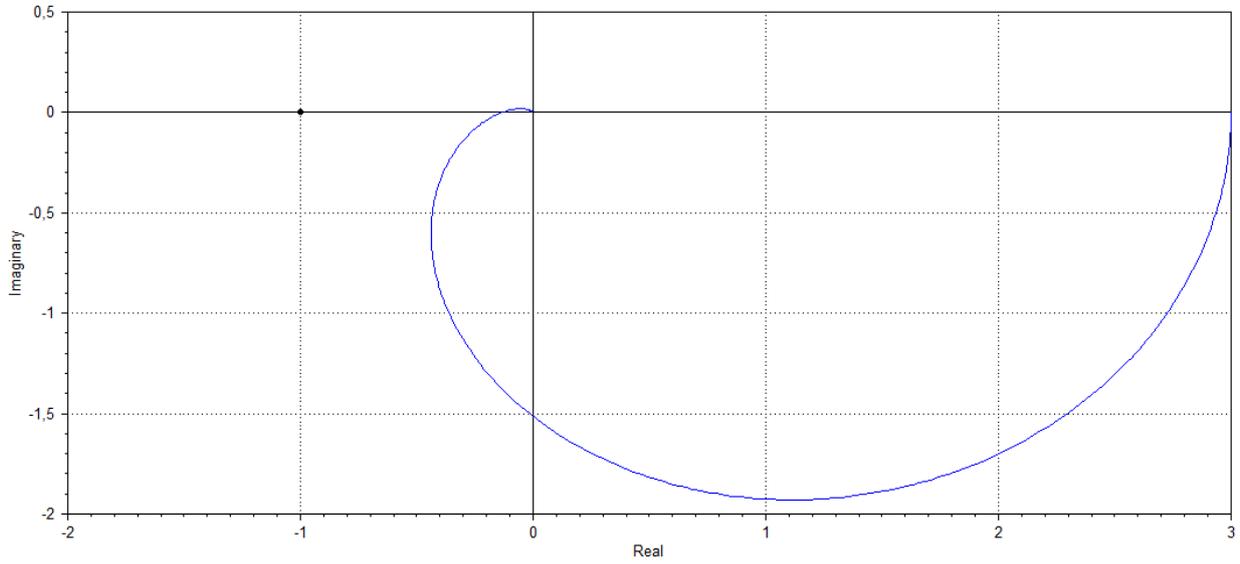
a2- Verificar en el Diagrama de Bode los valores calculados gráficamente.

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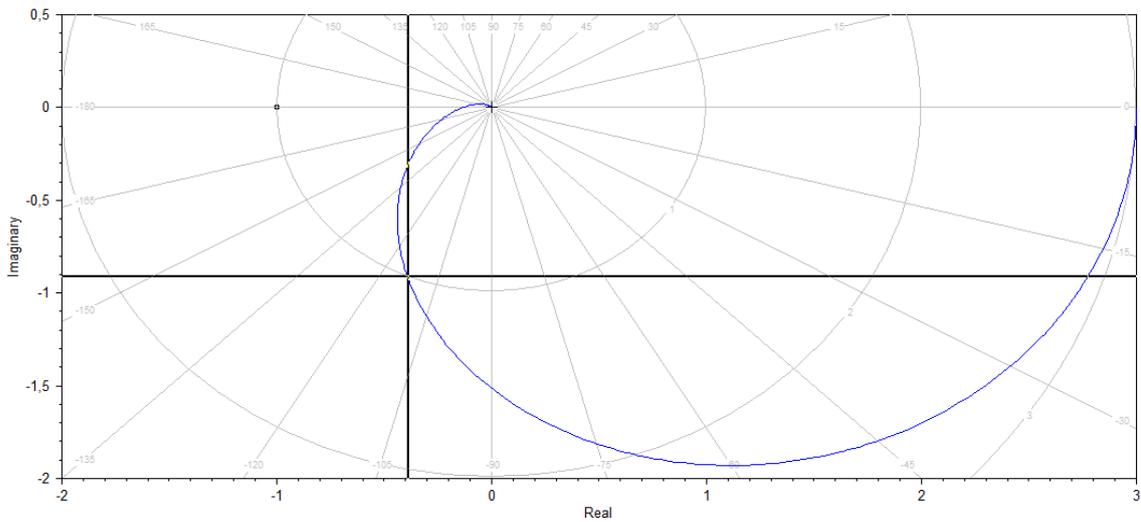
CC>w=1
CC>u=w/(s^2+w^2)
CC>time(u*s, g3*u*s)
CC>bode(g3)
CC>nyquist(g3)
CC>margin(g3)
  At w= 0,411 r/s, Phase margin= 67,16 deg, Delay margin= 2,85 sec
  At w= 0,466 r/s, Mp= 0,915 (-0,77 dB)
  At w= 1,36 r/s, Gain margin= 7,56 ( 17,57 dB)
CC>bode(g3)
CC>rl(g3)
  
```



Freq = 1,397 r/s, Mag = 0,1238 (-18,15 dB), Phase = -85,83 deg

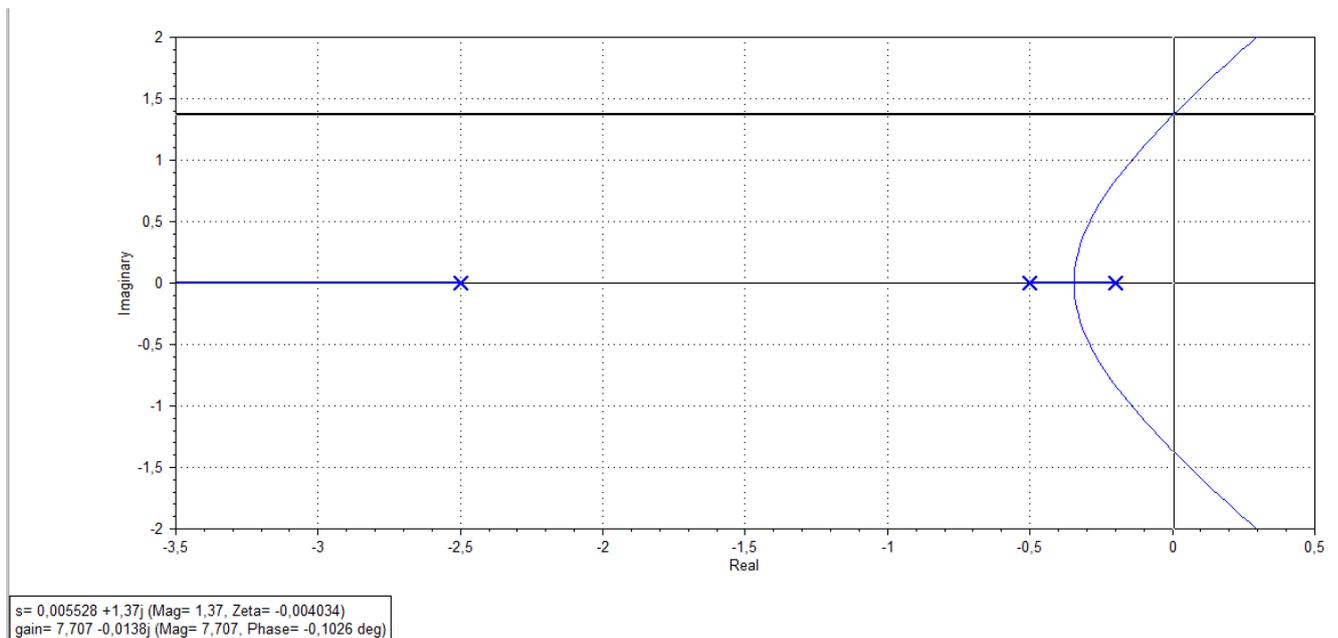


Real = -0,1206, Imag = 0,002315, Mag = 0,1206 (-18,37 dB), Phase = -181,1 deg



Real = -0,3869, Imag = -0,912, Mag = 0,9907 (-0,08096 dB), Phase = -113 deg

a3- Graficar el lugar de raíces y determinar K_{cu} y T_u



$s = 0,005528 + 1,37j$ (Mag= 1,37, Zeta= -0,004034)
gain= 7,707 -0,0138j (Mag= 7,707, Phase= -0,1026 deg)

a4- Determinar K_{cu} y T_u aplicando Método de Routh y Sustitución Directa (considerar realimentación unitaria y sistema SIN TIEMPO MUERTO)

a5- Calcular los ajustes óptimos aplicando Ajustes de Ziegler-Nichols

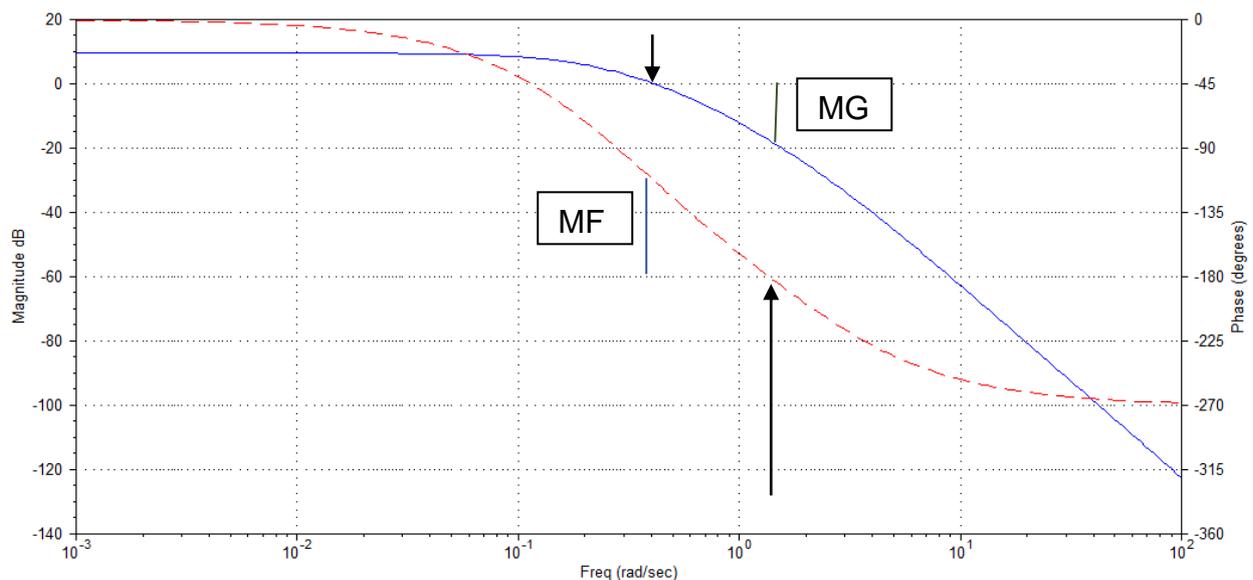
$K_{cu} = 7,56$ $w_u = 1,36$ $T_u = 2 * \pi / w_u = 4,62$

Tabla 6-1 Fórmulas para ajuste de razón de asentamiento de un cuarto.

Tipo de controlador		Ganancia proporcional K_C	Tiempo de integración τ_I	Tiempo de derivación τ_D
Proporcional	P	$K_{cu}/2$	—	—
Proporcional-integral	PI	$K_{cu}/2.2$	$T_u/1.2$	—
Proporcional-Integral-derivativo	PID	$K_{cu}/1.7$	$T_u/2$	$T_u/8$

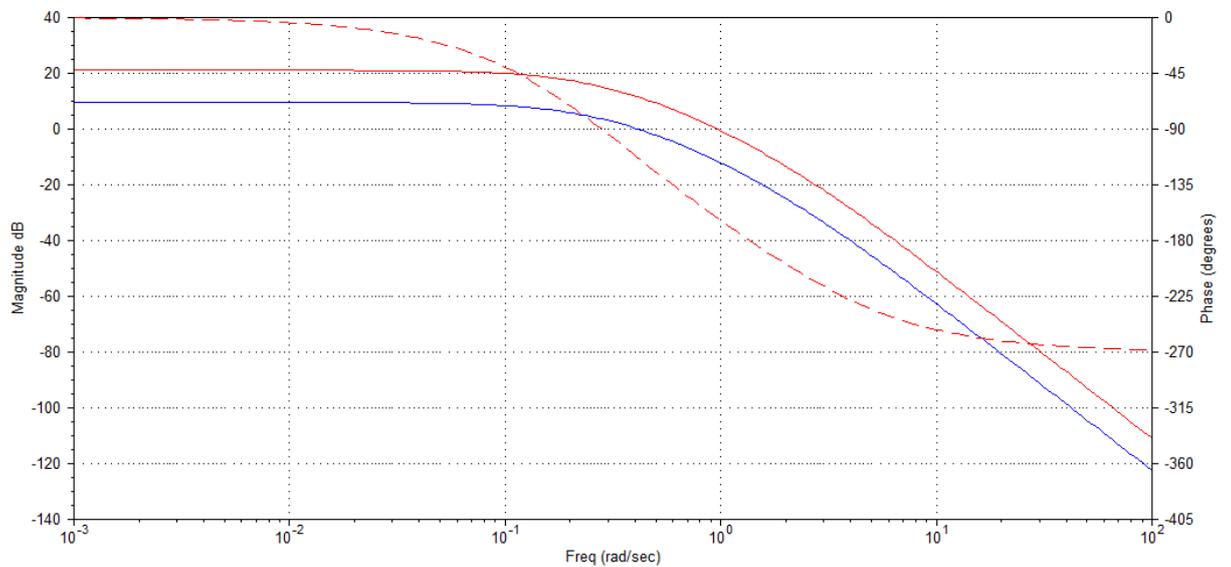
b-Para la función de transferencia de lazo abierto SIN TIEMPO MUERTO, graficar los Diagramas de Bode, Nyquist y Lugar de Raíces para los siguientes casos:

b1- Función $G_p(s)$ determinar: asíntotas, G_{ss} , constantes de tiempo, margen de ganancia y de fase, W_u y T_u , K_{cu} (gráficamente)



b2- Función $G(s)$ con controlador P (mostrar solo $G(s)$, solo $G_c(s)$ y $G(s)*G_c(s)$)
 $K_c = K_{cu}/2 = 3,78$

CC>bode(g3, g3*3.78)



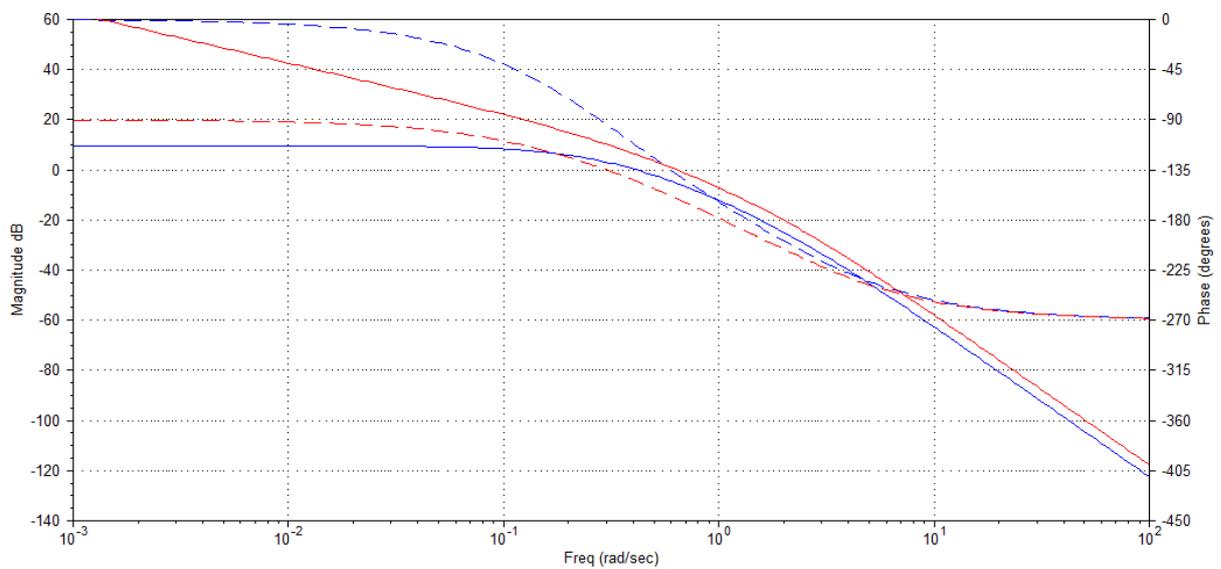
b3- Función $G(s)$ con controlador P+I (mostrar solo $G(s)$, solo $G_c(s)$ y $G(s)*G_c(s)$)

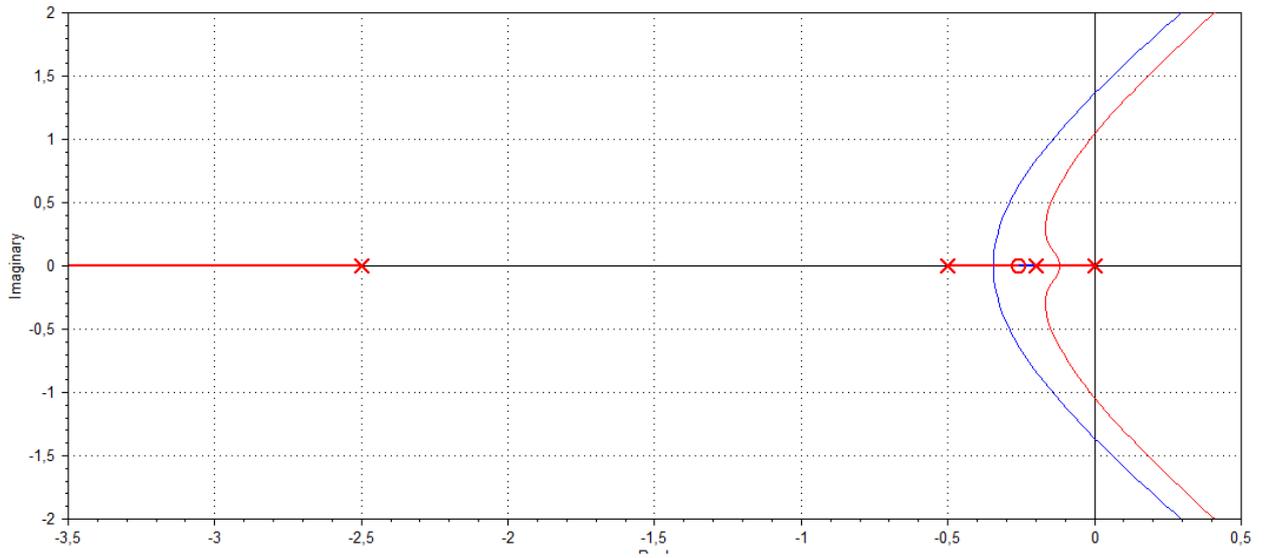
$K_c = K_{cu}/2, 2 = 1,72$

$I = T_u/1, 2 = 3,85$

```
CC>gpi=1.72*(1+1/(3.85*s))
CC>bode(g3, g3*gpi)
```

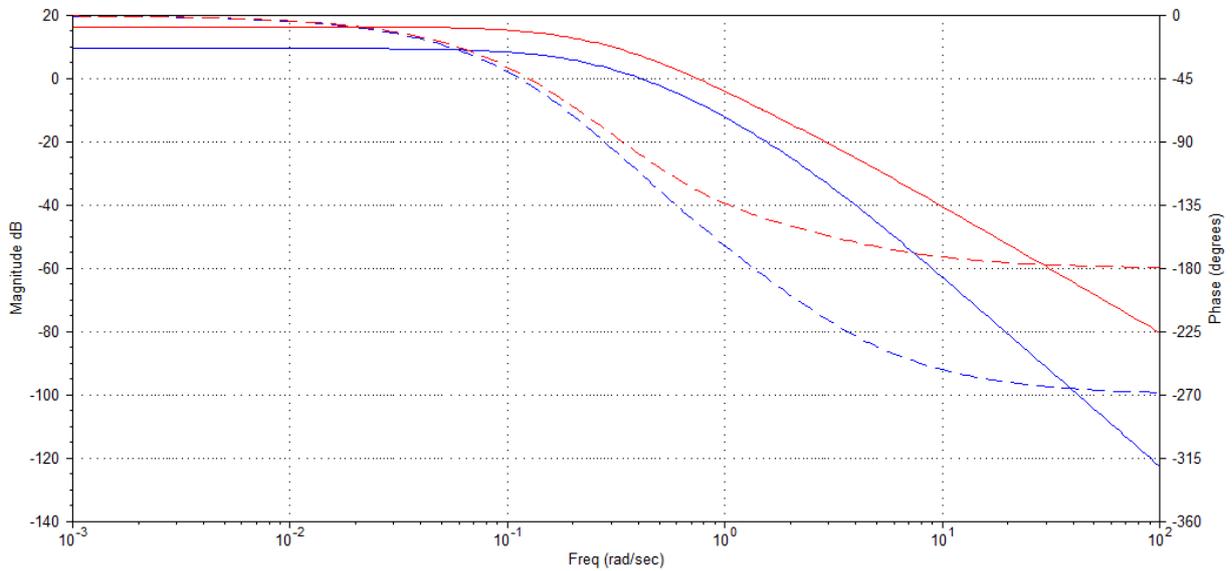
```
CC>r1(g3, g3*gpi)
CC>r1(g3, g3*gpd)
CC>r1(g3, g3*gpil)
```

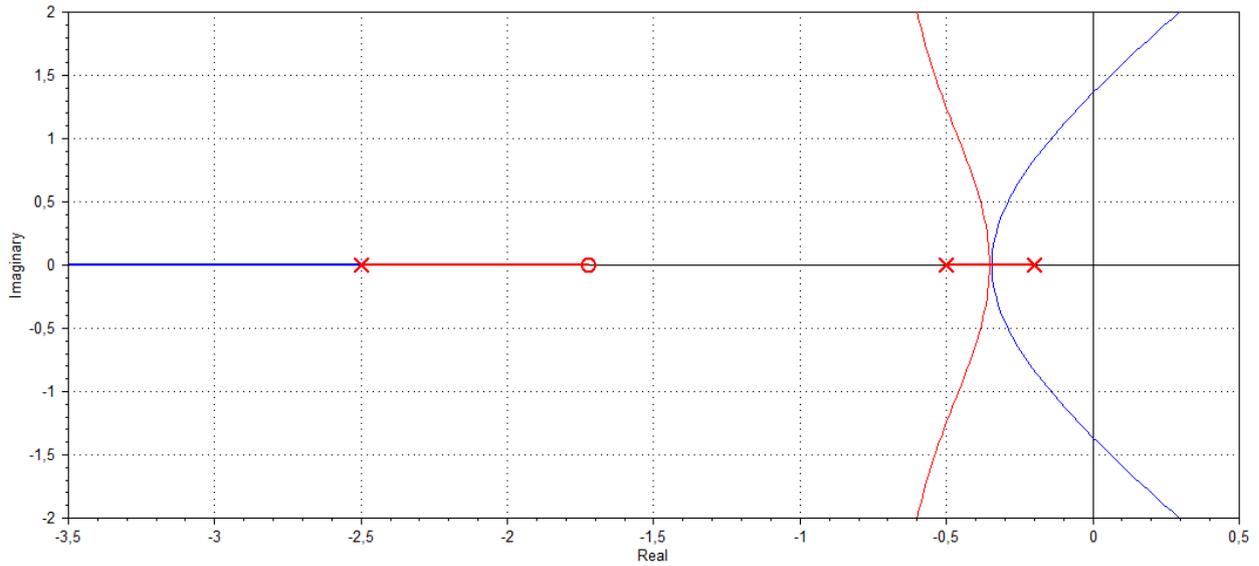




b4- Función $G(s)$ con controlador P+D (mostrar solo $G(s)$, solo $G_c(s)$ y $G(s)*G_c(s)$)
 $K_c = K_{cu}/1,7 = 2,22$ $D = T_u/8 = 0,58$

```
CC>gpd=2.22*(1+0.58*s)
CC>bode(g3, g3*gpd)
```





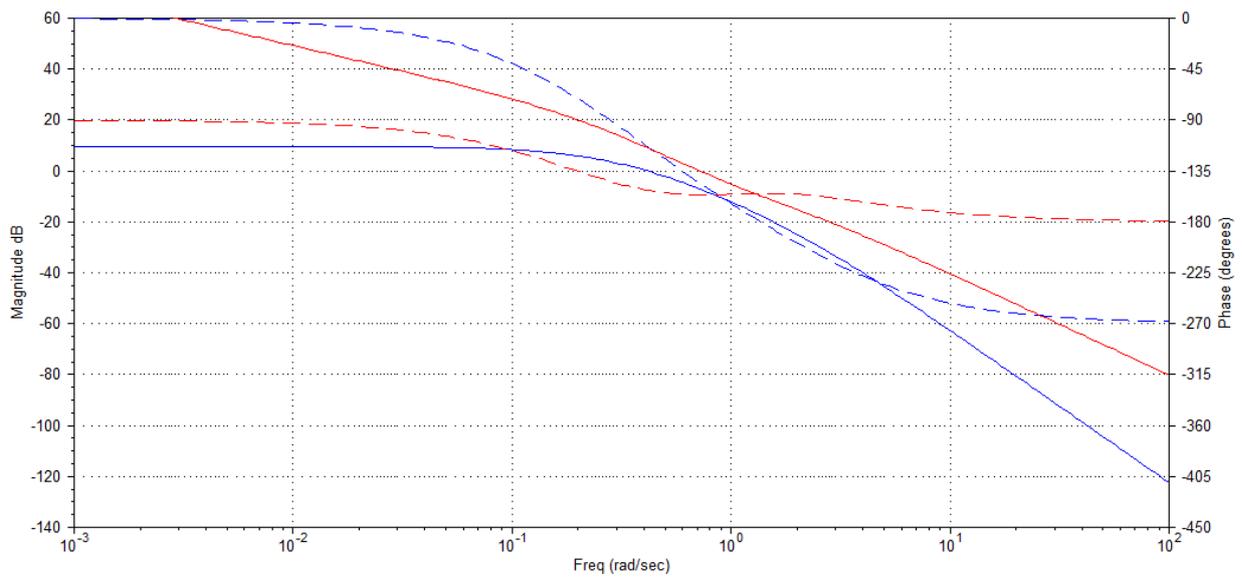
b5- Función $G(s)$ con controlador P+I+D (mostrar solo $G(s)$, solo $G_c(s)$ y $G(s)*G_c(s)$)

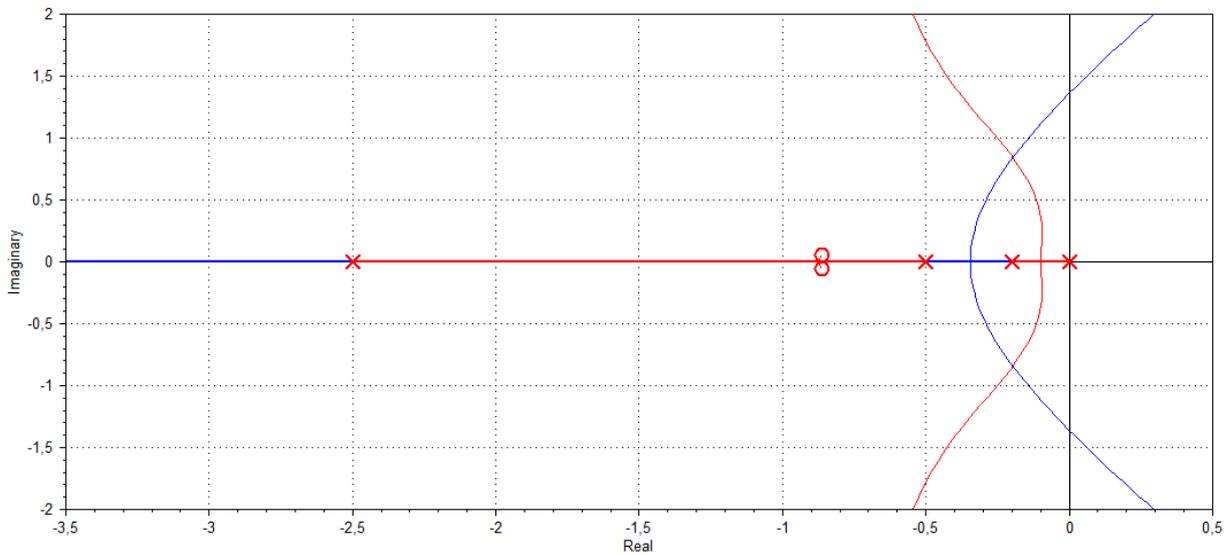
$K_c = K_{cu}/1,7 = 2,22$

$I = T_u/2 = 2,31$

$D = T_u/8 = 0,58$

```
CC>gpid=2.22*(1+(1/(2.31*s))+0.58*s)
CC>bode(g3, g3*gpid)
??
```

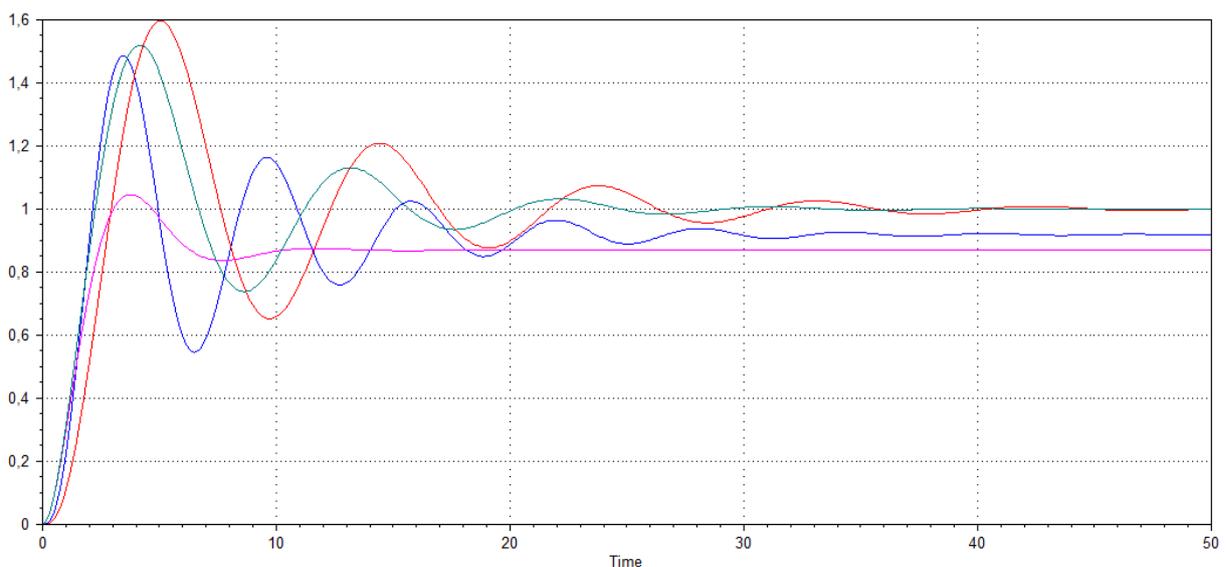




Conclusiones: como varia T_u , análisis de estabilidad y velocidad de respuesta

c- Respuesta temporal a lazo cerrado de cada uno de los casos del punto b.

```
CC>glcd1= ((g3*3.78) / (1+(g3*3.78)))
CC>glcd2= ((g3*gpi) / (1+(g3*gpi)))
CC>glcd3= ((g3*gpd) / (1+(g3*gpd)))
CC>glcd4= ((g3*gpil) / (1+(g3*gpil)))
CC>time(glcd1, glcd2, glcd3, glcd4)
```



Compararlas y revisar las conclusiones obtenidas en punto b.